Guinea) might be collected into a Melanesian sub-region, and subordinated to the Oriental Region. Since I have elaborated these views in another place, I will here limit my argument to a couple of supporting references.

(1) When Dr. Wallace first returned from his Eastern travel his impression of a natural region was one "extending from the Nicobars in the north-west to San Christoval, one of the Solomon Islands, on the south-east, and from Luzon on the north to Rotti, at the south-west angle of Timor, on the south" (Report British Assoc. 1863, *Trans.* p. 107).

(2) Dr. W. Botting Hemsley has stated: "There is no doubt that the combined Fijian, Samoan and Tongan flora is eminently Malayan in character" (*Journ. Linn. Soc.* Botany, xxx. p. 211).

To map New Zealand thus as an extreme and impoverished outlier of the Oriental or Malayan Region would express but a part of her affinities, since it would ignore the Antarctic relationship. But zoo-geographic problems are too complex to be expressed in terms of colour on a map. If, however, New Zealand and related areas must be forced into one or other of the recognised divisions, then I submit that this arrangement would do less violence to nature than that accepted in the text-books.

Australian Museum. CHARLES HEDLEY.

Mercury Jet Interrupters.

MY attention was attracted recently by a brief notice that appeared in NATURE of March 1 (p. 421) of a new form of mercury jet interrupter devised and placed on the market by Messrs. Isenthal, Potzler and Co.

As that form of break appeared to be of interest to the readers of NATURE, a short description of one that I designed some months ago, along similar lines, may be of interest to some.

While experimenting with wireless telegraphy an interrupter of great frequency of break seemed desirable, and as I wanted also to know the rate of interruption accurately, it was deemed best to use some form of mechanical one. After investigating several kinds, the following one was finally decided upon as the most promising:—

An iron vessel, arranged as a Mariotte flask to maintain a constant head, holding about a pint of mercury, formed one terminal and a metallic plate the other. The plate was arranged below the vessel, and the mercury fell upon it, completing the circuit. In the bottom of the flask was a row of ten holes, arranged around in a circle, with nozzles fitted into them. On a vertical shaft, concentric with the row of nozzles, a series of mica sectors were arranged, so that, when revolving, they would cut the mercury jets falling from the vessel above. These strips were placed with the line of their edges parallel to the axis of the shaft. Thus they would break the circuit in several places at the same instant, giving a very sharp break.

It was found better to break the circuit by interposing an insulator than to break by opening the circuit with a conductor, as the wear at the spark tended to keep them all equal, so they automatically adjusted themselves to the best positions.

The object of the row of jets was to get a more rapid interruption. To break a single jet in five or six places simultaneously, and at the same time with a satisfactory frequency, was found to require too great a head and velocity of jet to be practicable, so by adopting a row of ten the frequency could be increased that many times. These jets are all in parallel, and when the mica strips are revolving the head is so adjusted, by the Mariotte flask arrangement and screws on the sides of the reservoir, that at the instant of interruption of one jet, all the others are in a state of interruption; but the one directly in front of the mica strips will be the first to make the circuit. Thus it continues to break at a rapid rate.

Greater rapidity of break can easily be obtained by increasing the speed, by increasing the number of nozzles, by increasing the number of sets of mica strips, or by any combination of the three.

This form of interrupter will be found quite useful to any one desiring a known rate, high frequency interrupter.

S. M. KINTNER.

Western University of Penna, Allegheny, Pa., April 2.

Tyndall's Ice Crystals.

WOULD you, or some of your readers, kindly inform me whether the ice crystals, as shown in Tyndall's "Form of Water," p. 33, are considered to represent skeleton crystals or solid ones arranged in patterns? J. A.

Tunbridge Wells, April 14.

MARINE ZOOLOGY IN AUSTRALIA.[1]

IN these columns was noticed recently the admirable activity of the various Australian museums in making known to science the natural objects of southern lands and seas. On that occasion it was an important addition to our knowledge of mammalian palæontology—Prof. Stirling's description of *Diprotodon* remains—that was especially under discussion. Now we have to record equally important investigations in marine zoology undertaken by the staff of the Australian Museum, Sydney.

Besides "guides" and "miscellaneous publications," the Sydney Museum issues a series of "records" for minor papers; "catalogues," which are large and fully illustrated, contain descriptions of many new species, and are really in some cases monographs; and "memoirs," such as the natural history of Lord Howe Island (1889); that on the Atoll of Funafuti more recently, in ten parts; and, finally, the "Scientific Results of the Trawling Expedition of H.M.C.S. *Thetis*," of which Part i. is now before us. From the introduction, by Mr. Edgar R. Waite, we learn that this expedition was the outcome of a desire on the part of the Government of New South Wales to investigate the trawl fisheries of their coast. In 1898 H.M.C.S. *Thetis* was commissioned, the expedition was financed by the Colonial Government, and an experienced North Sea trawler was obtained, upon whose skill depended the successful working of the apparatus. Finally, the Trustees of the Australian Museum were asked to appoint one of their officers to join the expedition, and Mr. Waite was selected to act in that capacity. He tells us how a large and valuable collection was obtained and preserved (not without considerable difficulty, as experience showed that the *Thetis* was a most unsuitable vessel for the purpose), and promises that the various groups will be dealt with in detail by members of the museum staff in succeeding parts of the memoir. An "Addendum to the Introduction" on fishing with electric light—not yet brought to perfection—concludes with the sentence: "I lowered an incandescent lamp in a tow-net, and obtained a number of small invertebrates, thus reproducing the experiments conducted at the Liverpool Biological Station" (p 132). He does not tell us what the forms were which were obtained in the illuminated net. In the Liverpool experiments they were all actively swimming forms provided with eyes.

The remainder of the present part contains Mr. Waite's report upon the fishes. One hundred and seven species were taken, representing ninety-five genera, including one new genus, viz. *Paratrachichthys* (formed for *Trachichthys traillii*, Hutton). Nine new species are described, a number of others are new records for the colony. But it is very evident that, as Mr. Waite says, "the interest of the results is, however, not exhausted by an enumeration of the new or rare species; the expedition has been the means of materially extending the known range, both geographically and vertically, of several of our common food fishes. The breeding season of one or two species has been ascertained, . . . and our knowledge of the habits of the soles has also been extended." As the trawling was for the most part not carried on in really deep water, but within the limit reached by line fishermen, the scientific and economic success was all the more marked. As an example of the latter may be taken the information as to *Zeus australis*, a rare and valuable food fish, which was found under circumstances indicating that it may yet take its place as a popular and cheap food fish.

Of the nine new species described, perhaps the most interesting is the "ghost-shark" (*Chimaera ogilbyi*),

[1] Australian Museum, Sydney. Memoir IV. "Scientific Results of the Trawling Expedition of H.M.C.S. *Thetis*," &c. Part i. Pp. 132; 31 plates, frontispiece, and a chart. (Sydney, 1899.)

this being the first record of the genus south of the equator in the Eastern Hemisphere—seven specimens were taken, all, unfortunately, females.

The results of this expedition are evidently such as to encourage the Colonial Government in continuing the work, as Mr. Waite has been able, not only to add to scientific knowledge, but to obtain much information directly bearing on the fisheries. If all of our Sea Fishery Districts Committees were to combine in carrying on similar operations round our own coast, notable progress would be made towards obtaining that approximate "census" of our territorial waters which is required for the solution of both scientific and economic problems.

W. A. Herdman.

THE ORIGIN AND OCCURRENCE OF CAVE-ICE.

Although ice-caves and their phenomena present some of the most interesting problems in the whole range of physical geography, it is singular to note how comparatively little attention has been directed to their investigation, and how inadequate still is the sum total of observation and experiment hitherto carried out, for the full elucidation of the many questions which arise in connection with their study. A recent investigator in this field of research is Dr. Hans Lohmann, who, in an admirable treatise on cave-ice ("Das Höhleneis unter besonderer Berücksichtigung einiger Eishöhlen des Erzgebirges," Jena, 1895), has brought together the results of previous work on the subject, and incorporated an account of his own observations in the ice-caves of Saxony. It is here only possible to set forth in the merest outline some of the more interesting facts connected with these natural ice-stores, and to indicate in brief the theories that have been advanced to account for some of their phenomena.

Ice-caves have been defined as natural or artificial cavities in the earth, in which ice, formed within them, is preserved either the whole year round or for a greater part of it. They may be roughly divided into two classes, termed by Thury "static" and "dynamic," or, according to Fugger, the ice-caves properly speaking and the "wind passages." The first are blind caves with only a single outlet, while the caves of the second class have connection by passage or cleft between their inner end and the outside air at some point in the hillside higher than the main entrance. Almost all known ice-caves are situated in the north temperate zone (roughly, between 40° and 60°), and the few exceptions which lie nearer the equator are so highly situated that in winter the temperature within them falls below the freezing point. Generally speaking, the caves do not lie in high mountain regions, though all are located where snowfall is possible.

The causes which bring about the formation of the ice are to be looked for solely in the meteorological and climatic conditions of the localities in which the caves occur. In the case of blind caves, the floor of the cavity is situated at a lower level than that of the entrance, and when the outer atmosphere becomes cooled below the temperature of the inner air, the former, by reason of its greater density, sinks into the cave, slowly displacing the contained air and thus giving rise to an air-current which brings about the chilling of the cave. When the outside temperature rises, that of the cave begins to rise also, but only slowly at first, because the warmer outside air possessing a smaller specific gravity can no longer sink into the cave, and the heat is conducted to the interior very slowly. During such periods (the "closed periods" of Trouillet) a temperature curve, shown by a registering thermometer placed within the cave, assumes the form of an almost straight line. The inner temperature then lingers for a long time in the neighbourhood of the freezing point, but rises again with comparative rapidity when all the contained ice is at last melted.

The cold produced by evaporation within the cave also tends to lower the temperature, and in those ice-caves classed as "wind passages" the influence of evaporation in this direction is very marked. While in summer the air contained in the blind caves is perfectly still, a strong air-current is found to prevail at this season in the wind-passages. It has been observed that when the outer temperature was considerably higher than that within, the wind-stream was passing outwards; at such time as the inner and outer temperature were alike, the current was intermittent or not observable; but when the outer temperature was lower than the inner, the draught was passing inwards. In such cases we have two separate air columns of equal height, one situated within the mountain, the other formed by the outer atmosphere. As soon as a difference of temperature in the two columns is brought about, the tendency to restore equilibrium gives rise to the air-current through the cave, as a result of which the latter becomes cooled in the winter and gradually warmed during the summer. But the downward current which prevails in summer may sometimes bring about a considerable cooling within the cave through evaporation, and if the outer air be very dry the formation of ice may even take place. Systematic observation has made it clear that the potent factor in the production of ice within the caves is the air-current.

The ice itself, formed principally during the spring-time, when the conditions of temperature and water supply are most favourable, is distributed in a varying manner; it may clothe the floor, the walls and the roof as a close-fitting sheet, or may hang in curtain-like form from the roof, or give rise to the formation of ice-stalactites and stalagmites, according to the distribution and manner of the water supply from above.

In connection with the thawing of ice-stalactites, an interesting phenomenon may sometimes be observed. Since the collecting point of the drip which gave origin to the stalactite is situated in the centre of the base of the latter, the thawing action of the water from above may proceed in such a way as to eat out the centre of the stalactite, leaving its peripheral parts hanging as a mere shell or tube. This has been explained by the fact that the warmer water introduced, having a greater specific gravity than water at the freezing point, will tend to sink to the base of the little hollow formed at the root of the stalactite as a first result of thawing, and thus rapidly carry out its work as a vertical borer.

But perhaps the most interesting phenomenon exhibited by cave-ice, to the description and elucidation of which Dr. Lohmann has devoted special attention, is the peculiar structure known as the "prismatic" or "honeycomb" structure. At certain times the surface of the ice is found to be broken up by a net-like system of fine crevices, resulting in the production of meshes of varying and more or less irregular form. It has been found that, strictly speaking, this structure does not appear during the winter, nor does its formation occur in all cases at the same time of the year. While in some caves this splitting process has never been observed to take place before the end of August, the ice in the caves of Saxony have exhibited the structure in an advanced stage as early as the month of March. The size of the meshes is very variable, and they may reach dimensions so great as 400 square centimetres, or be so minute as to be observed with difficulty by the naked eye. The crevices may be merely superficial, or may penetrate the ice to a depth of several centimetres, there to cease abruptly, and thus give rise to a superficial "prismatic layer" sharply separated from the compact ice beneath. But the development of honeycomb structure often proceeds so far that a thin ice-sheet is completely penetrated